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ABSTRACT

Although speech-language pathologists are expected to be able to administer and interpret oral examinations, there are currently no screening tests available that provide careful administration instructions and data for intra-examiner and inter-examiner reliability. The Oral Speech Mechanism Screening Examination (OSMSE) is designed primarily for use by clinical speech-language pathologists. The examination could also serve, however, as a useful tool for oral myofunctional therapists, as well as physical therapists, dentists, and orthodontists interested specifically in speech. It is reliable, relatively easy and quick to administer, and appropriate for children and adults in either diagnostic or therapy settings. The OSMSE is intended to assess those anatomical structures and physiological functions that are most often considered to be potentially related to speech or language disorders. Structural and/or functional judgments included are organized on the OSMSE test form under categories of: lips, tongue, jaw, teeth, hard palate, soft palate, pharynx, breathing, and diadochokinesis. Results of a preliminary study with normal speaking subjects indicated that the OSMSE had satisfactory intra- and inter-examiner reliability after minimal training. The time required to administer the examination typically ranged from 5 to 10 minutes. (Author/GK)

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THE ORAL SPEECH MECHANISM SCREENING EXAMINATION

By Kenneth O. St. Louis
and
Dennis M. Ruscello

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Oral Speech Mechanism Screening Examination (OSMSE)

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PREFACE

Most speech-language pathologists are expected to be able to differentiate those clients who have no apparent deviations in structure or function of the oral speech mechanism from those who may have some structural or functional deviations. The latter group are typically examined further by the speech-language pathologist, or are referred to another appropriate professional (e.g., orthodontist or neurologist). Although speech-language pathologists are expected to be able to administer and interpret oral examinations, there are currently no screening tests available that provide careful administration instructions and data for intra-examiner and inter-examiner reliability.

The Oral Speech Mechanism Screening Examination (OSMSE) was designed to provide such a test, that is, an examination that is reliable, relatively easy and quick to administer, and appropriate for children and adults in either diagnostic or therapy settings.

The OSMSE is intended to assess those anatomical structures and physiological functions that are most often considered to be potentially related to speech or language disorders (Emerick and Hatten, 1979; Hutchinson, Hanson, and Mecham, 1979; Dworkin, 1978a; Spriestersbach, Morris and Darley, 1978; Mason and Simon, 1977; Nation and Aram, 1977). Observation targets and tasks were selected after careful consideration of 1) the average clinician's training and ability to make accurate, reliable judgments and 2) potential usefulness of the information obtained. These decisions were reached on the basis of experience with a similar oral examination used at the West Virginia University Speech Clinic as well as the current literature (noted above) on oral examinations.

Structural and/or functional judgments included are organized on the OSMSE test form under categories of: lips, tongue, jaw, teeth, hard palate, soft palate, pharynx, breathing, and diadochokinesis. It must be re-emphasized here that the purpose of the OSMSE is *screening*. Obviously, a comprehensive examination would need to contain many additional items—and be very time consuming—if every potential disability were to be exhaustively tested and described.

Results of a preliminary study with normal speaking subjects (St. Louis et al., 1979) indicated that the OSMSE had satisfactory intra- and inter-examiner reliability after minimal training. The time required to administer the examination typically ranged from 5 to 10 minutes.

The OSMSE is most appropriate for clinical speech-language pathologists. The examination could also serve, however, as a useful tool for oral myofunctional therapists, as well as physical therapists, dentists, and orthodontists interested specifically in speech.

ACKNOWLEDGMENTS

The Oral Speech Mechanism Screening Examination (OSMSE) is the product of a multitude of influences and the result of dedicated assistance from many of our colleagues, friends, and families. We owe a great deal to our teachers, our clients, and our students for the training, experience, and feedback that led us to realize the need for this instrument. We thank Pamela J. Barry, Diane S. Grofic, and Karen J. Barr for their efforts in collecting and analyzing reliability data and preparation of a training videotape. We also are grateful to Drs. Edwin V. Kluth and William R. Merrow for their valuable assistance and suggestions. We ow particular thanks to Charles M. Smith, Jacob R. Young, and Nick Smith, of the WWVU-TV studios for their professional aid in preparation of the videotape. Financial support of the West Virginia University Foundation, Inc. is also gratefully acknowledged. We thank and acknowledge the WVU University Affiliated Center for their assistance in preparation of the final manuscript. Finally, we recognize the help provided by our families, particularly Scott, Edie, and Melinda, who so willingly helped us with this project.

K.O.S.L. and D.M.R.

ADMINISTRATION OF THE ORAL SPEECH MECHANISM SCREENING EXAMINATION (OSMSE)

Examiner Qualifications and Training

The Oral Speech Mechanism Screening Examination (OSMSE) is designed primarily for use by clinical speech-language pathologists. It is assumed that the examiner has undergone academic training in anatomy and physiology of the speech mechanism, that is, the breathing, voicing, articulating, and resonating structures and their functions. Examiners who have not had such training should refer to a standard speech anatomy textbook such as Zemlin (1968). Obviously, examiners need a substantial background in the various speech and language disorders with which they come in contact and in the experimental literature that relates anatomic or physiologic deviations to speech and language ability.

The OSMSE could be administered by physical therapists who are interested in oral functioning, by dentists and orthodontists or their specially trained assistants, and by myofunctional therapists.[1]

All examiners, regardless of their training, should carefully read the entire manual before administering the test. In addition, the examiners should practice giving and scoring the examination with individuals of various ages before using it in a diagnostic evaluation.

To assist the examiner who wishes to use the OSMSE, a 20-minute training videotape that shows a speech-language pathologist administering the OSMSE to a normal child has been prepared.[2] The examination format, special tools, interaction with the client, and scoring are among the topics presented on the tape. The training tape, however, is supplementary; this manual is self-contained and provides all the information necessary to learn to administer, score, and interpret the OSMSE.

Testing Instruments

To carry out the Oral Speech Mechanism Screening Examination, the clinician must have certain instruments for positioning and observing the various structures. Tongue blades (depressors), a flashlight, and tissues are necessary, and the use of a stopwatch also is recommended.

Administration Instructions

Preparation for the Examination The client should be positioned in a way that enables unobstructed observation by the clinician, provides little disruption to the act of speaking, and is not uncomfortable. The client should sit in a straight-back chair with the clinician seated in front of him or her or in a crouch position. Sometimes it is important to reassure younger clients that the examination will not be painful. If a child seems visibly upset with any part of the examination, that portion should be excluded or postponed. Some children, for example, may object to the insertion of tongue blades in the mouth. Some excellent suggestions for persuading the child to cooperate are provided by Emerick and Hatten (1979). The procedures and observations discussed in this manual can be carried out with most individuals seen in the clinic, school, or hospital.

Scoring System Figure 1 is a completed test form. Because the examination was de-

[1]The authors in no way wish to take a position regarding the advantages or disadvantages of myofunctional therapy. For an extensive bibliography of the literature, the reader is referred to the statement of the Joint Committee on Dentistry and Speech Pathology-Audiology (1975).

[2]The color videotape can be purchased from the authors. Interested persons can contact the authors at: Department of Speech Pathology and Audiology, 805 Allen Hall, West Virginia University, Morgantown, West Virginia 26506.

ORAL SPEECH MECHANISM SCREENING EXAMINATION

Kenneth O. St. Louis, Ph.D. and Dennis M. Ruscello, Ph.D.
West Virginia University

Name Scott Type of Client Sample

Examiner Pam Date _____ Date of Birth _____

SCORING KEY
+ No Deviation Noted
– Deviation Noted
NT Not Tested
NR No Response
X Wrong Response
→ Asymmetry on Right Side
← Asymmetry on Left Side

STRUCTURE	APPEARANCE	NONSPEECH FUNCTION Task	Response
Lips	Symmetry at Rest [+] Other Deviations Noted:	Instructions: "Watch me and do what I do" Round Lips Draw Corners Back Close Lips; Puff Cheeks Bite Lower Lip	[+] [+] [+] [+]
Tongue	Surface [+] Frenum [+] Other Deviations Noted:	Tip Up Tip Down Tip Right Tip Left Tip Drawn Back Along Hard Palate	[+] [+] [+] [+] [+]
Jaw	Occlusion: Lateral View of First Molars Normal Relationship Posterior ← → Anterior (✓) Yes ( ) No. (1) *Sketch* Lower First Molar (2) Check (√) ( ) Maxilla Protruded Anteriorly (Mandible Retruded Posteriorly) (Distocclusion) ( ) Maxilla Retruded Posteriorly (Mandible Protruded Anteriorly) (Mesiocclusion)		
	Lateral View of Central Incisors Normal Relationship Posterior ← → Anterior (✓) Yes ( ) No. (1) *Sketch* Lower Central Incisor (2) Check (√) ( ) Upper Incisors Cover More Than 1/3 of Lower Incisors ("Closebite") ( ) Upper Incisors Do Not Cover Lower Incisors ("Openbite") ( ) Upper Incisors too Far Anterior Relative to Lower Incisors ("Overbite") ( ) Upper Incisors Posterior to Lower Incisors ("Underbite") ( ) Other Deviations Noted:		

9

10

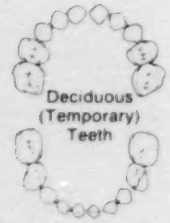
Teeth

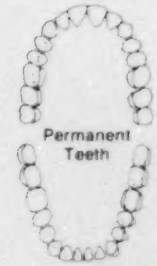
Condition:
( ) Obvious presence of caries or decayed teeth:
( ) Gap(s) created by missing teeth (Circle teeth representing gaps):

Alignment:
( ) Excessively wide spaces between teeth noted (Draw arrow(s) between teeth):
( ) Excessively crooked teeth noted Describe:

Bridges; Appliances; Prostheses:

Other Deviations Noted:





Hard Palate

Vault Height [+]:
Vault Width [+]:
Other Deviations Noted:

Soft Palate

Symmetry at Rest [+]:
Uvula [+]:
Other Deviations Noted:

Pharynx

Anterior Faucial Pillars [+]:
Posterior Faucial Pillars [+]:
Palatine Tonsils [+]:
Other Deviations Noted:

Say "ah" (3 trials)

	MOVEMENT OBSERVED		SYMMETRY OF MOVEMENT
	None	Some	
Vertical Movement	( )	(✓)	(✓)
Lateral Movement	( )	(✓)	(✓)

VELOPHARYNGEAL MECHANISM

	Yes	No
Sustain /u/, voice quality change perceived with nostrils occluded and open	( )	(✓)
Hypernasality perceived	( )	(✓)

Breathing

Mouth Breather ( ) Yes (✓) No
Other Deviations Noted:

Diadochokinesis

Task	Number	Time (Seconds)	Repetitions Per Second	Rhythmic Yes	Rhythmic No	Articulation Accurate Yes	Articulation Accurate No
pa. pa. pa	16	4½	3.6	(✓)	( )	(✓)	( )
ta. ta. ta	16	4	4.0	(✓)	( )	(✓)	( )
ka. ka. ka	16	4	4.0	(✓)	( )	(✓)	( )
pata. pata. pata	12	5	2.4	(✓)	( )	(✓)	( )
pataka. pataka. pataka	8	5½	1.5	(✓)	( )	(✓)	( )

SUMMARY AND RECOMMENDATIONS:

Oral speech mechanism appears normal
No recommendations.

Figure 1. A completed OSMSE form.

signed as a screening instrument, the scoring system contains a limited number of response choices. For most items, the examiner will use the scoring key on the score sheet. Brackets indicate the need for a response from the scoring key. If a structure or selected test movement seems appropriate, use a plus sign [+] to indicate that no deviation was noted. Use the minus sign [−] when a deviation in structure or function is observed. The [NT] signifies that an item was not evaluated. In case of functional movement, the lack of response is signaled with the abbreviation [NR] and the incorrect execution of a movement is marked with the symbol [X]. The final response category allows the examiner to mark any instances wherein the appearance or functional movement of a structure shows some form of asymmetry. If asymmetries are noted, use directional arrows, [→] or [←], to indicate the orientation of the noted deficiency.

In addition to the above scoring procedures, the examiner is also required to observe a specific structure or function and mark an appropriate category description or note specific performance on tasks dealing with speech movements. Such judgments can be indicated by a check mark within parentheses. This is done to facilitate interpretation and reduce administration time. This latter type of response recording was found to be most useful when examining the jaws, occlusal relationships, and the teeth.

Lips The lips are examined initially. First, observe the individual's lips at rest to note the general appearance and symmetry. If a scar is present as the result of a cleft lip repair, note this in the appropriate section. Following the initial observations, evaluate lip mobility by having the client perform a number of nonspeech movements. Ask the client to watch you while you make the required movements, then ask the client to do the movement. Observe each movement and score on the test response sheet.

Tongue As with the other oral structures, there is a great deal of acceptable variation in the structure and function of the tongue. Observe the tongue by asking the client to open his or her mouth. Note the tongue surface and size in relation to the oral cavity. Inspect the lingual frenum by having the client elevate the tongue and touch the upper teeth while the mouth is open.

After inspecting the tongue, evoke nonspeech movements with the appropriate verbal and imitative cues. The movement testing is done in the same fashion as that mentioned above for the lips. The person must elevate the tongue tip toward the nose, orient the tongue toward the chin, and touch both corners of the lips. The final movement, sweep back, requires the person to make tongue-palate contact and move the tongue as far posteriorly as possible, while maintaining the contact.

Jaw Observations of the jaw are mainly delegated to the occlusal relationships of the upper jaw (maxilla) and lower jaw (mandible). When the teeth and jaws are in proper alignment, the upper and lower dental arches exhibit correct anterior-posterior and lateral relationships with each other. The upper jaw is larger than the lower jaw. A reference point for observation of occlusion is the relation between the upper and lower first permanent molars. The upper first molar closes about one-half its length behind the lower first molar. Occasionally, young children in the deciduous ("baby") teeth stage display an end-to-end first molar relationship instead of the condition described above.

Observations of occlusion are often problematic for speech-language clinicians. This section of the examination includes short summary descriptions of possible occlusal relations. In this way, the examiner may observe a particular occlusal relationship and simply check the appropriate description.

The examiner first observes the relation between the upper and lower first molars. If they are in the expected relation, the appropriate "yes" blank is checked. If they are not, the "no" blank is marked, and the relation of the lower and upper molar is drawn within the circle. The anterior portion of the dental arch is also examined, and the same steps as indicated above are employed. Next, the examiner proceeds to the column at the right and checks whether normal occlusion or some type of malocclusion has been observed. The alternative classifications along with descriptive summaries are provided. The remaining alternatives describe certain anterior occlusal problems that may be noted in the examination. There also is a space in which to note any other deviations..

Teeth Any deviations noted with individual teeth are noted in this section of the examination. Obvious dental caries, severely decayed

teeth, and missing teeth that have resulted in large gaps in the dental arch should be marked on the diagram provided. Mark instances of wide spaces (diastemae) between teeth by placing a line between the teeth where the spacing exists. Individual teeth that seem grossly malaligned should be noted by marking the designation "crooked teeth" and should be described as necessary. Because many of the 6- to 13-year-olds seen in evaluation are in the mixed dentition stage (part deciduous and part permanent), the examiner should be careful in marking the correct dental arch on the score form.

The examiner should also note in the space provided any bridges, appliances, prosthetic devices, or any deviations observed.

Hard Palate For the most part, examination of the hard palate will involve relative judgments of the width and height of the hard palate. The hard palate forms the roof of the mouth and is readily accessible for visual inspection. There is wide range in palate structure, therefore, only gross deviations should be noted. If a client was born with a cleft of the hard palate, the examiner should indicate the presence of any scarring and should inspect for any other problems.

Soft Palate The soft palate should be observed when it is at rest and during phonation. Sometimes it is difficult to observe the palate at rest because of enlarged tonsils or because the back of the tongue interferes with observation. In most cases, however, there should be no problem because a tongue blade may be used to lower the tongue. The clinician should have the patient open his or her mouth and keep the head in the upright position. The soft palate and uvula should be observed for symmetry at rest, and any deviations should be noted. During production of the vowel /a/ the examiner should make note of the vertical (upward and backward) movement of the soft palate and any lateral movement (constriction toward the midline) of the pharyngeal walls. At least three trials should be taken for this task. Movement or lack of movement should be marked where appropriate. If movement is observed, the clinician should indicate whether the movement was symmetrical. In addition to the above procedures, ask the client to prolong the vowel /u/ while you alternately open and occlude the nostrils. If voice quality changes are perceived, the appropriate boxes should be checked so that further evaluation of a possible velopharyngeal deficit might be carried out.

Pharynx The oropharynx can also be viewed when observations of the palate are made. The clinician should view the anterior and posterior faucial pillars and palatine tonsils. Occasionally, the palatine tonsils in children are rather large and may occupy a great deal of space in the oropharynx.

Breathing There are no formal guidelines for this section, but excessive mouth breathing should be marked, if present. Any other deviations pertaining to breathing may be described in this section.

Diadochokinesis A speaker's motor coordination and control of the major articulators is assessed through determination of maximum rates for diadochokinetic speech movements. The mobility of the lips and tongue are evaluated singly and in combination. The number of repetitions to be taken for each subtask are provided. The clinician must have a stopwatch or a clearly visible clock or watch showing seconds for time and a method for accurately counting the responses. It is recommended that the examiner use the four fingers of one hand to aid in counting each movement because the required totals are all multiples of 4. For example, to determine the time required for 16 /pʌ/ syllables, first model at least 10 rapid repetitions for the client. Next, ask the client to practice briefly, reinstructing them if necessary. Then, tell the client to start repeating the syllable as fast as possible when told to begin, and to continue until told to stop. Start counting when the stopwatch is started or the second hand of a clock or watch passes a clearly visible reference point. As the client repeats, count each trial on the fingers of one hand (keep the hand pressed unobtrusively against your leg). When all fingers have been used four times, 16 repetitions have been completed. All you need to do is keep track of the number of four finger excursions while watching the time. If the client utters the single syllables very rapidly, the examiner, with practice, can learn to count every second unit on each finger so that 16 repetitions involves only two excursions through the four fingers.

If the finger counting method is too difficult for some inexperienced examiners, the diadochokinetic rates can be tape recorded and counted later. In this case, each task can be counted by shifting to a slower playback speed,

which will permit slower, more accurate rate counts. After the OSMSE is completed, the examiner can then convert the times in seconds to repetitions per second by referring to Table 1 or by dividing the number of repetitions by the recorded times.

In addition to recording repetition rates, the examiner must make judgments about the speaker's rhythm and adequacy of articulation for each diadochokinetic task.

Summary and Recommendations After the OSMSE score form has been completed, the examiner should review the findings carefully. A brief summary statement or paragraph that integrates salient results pertaining to the adequacy of the oral mechanism for speech should be written. If no obvious deviations were found, this should be noted. On the other hand, if the examiner believes that various abnormalities in structure or function might contribute to the speech or language disorder, a suggestive statement to that effect should be included. Such statements should be regarded and stated as working hypotheses to be proved or disproved by further observation and testing.

Once the summary statement is made, the examiner should carefully consider the possible alternative courses of action to take regarding the client. These might include referrals to other professionals, further testing, or specific remedial procedures.

It is recommended that the examiner consider the best courses of action open to the client, even though they may not be practically or economically feasible. Then, after the "ideal" recommendations have been determined, pragmatic, limiting considerations should be discussed with the client or his or her parents or guardian to arrive at the best possible compromise. In this way, it is the client—not the examiner—who ultimately decides what is practically and economically feasible.

The space provided on the score form usually is sufficient to summarize the results of the OSMSE. If not, an extra sheet should be attached.

Table 1. Table for converting time (in seconds) to repetitions per seconds for diadochokinetic tasks on the OSMSE

Time (in seconds)	Repetitions per second		
	16 Repetitions (pʌ; tʌ; kʌ)	12 Repetitions (pʌtə)	8 Repetitions (pʌtəkə)
1.0	16.0	12.0	8.0
1.5	10.7	8.0	5.3
2.0	8.0	6.0	4.0
2.5	6.4	4.8	3.2
3.0	5.3	4.0	2.7
3.5	4.6	3.4	2.2
4.0	4.0	3.0	2.0
4.5	3.5	2.7	1.8
5.0	3.2	2.4	1.6
5.5	2.9	2.2	1.4
6.0	2.7	2.0	1.3
6.5	2.5	1.8	1.2
7.0	2.3	1.7	1.1
7.5	2.1	1.6	1.1
8.0	2.0	1.5	1.0
8.5	1.9	1.4	0.9
9.0	1.7	1.3	0.9
9.5	1.7	1.3	0.8
10.0	1.6	1.2	0.8

INTERPRETATION OF THE OSMSE

Overall Guidelines

As noted above, the purpose of the OSMSE is to provide the speech-language pathologist with a method for assessing the adequacy of the oral mechanism for speech. There is an extreme range of normality in structure and function of the oral speech mechanism, and it is difficult to establish causal relationships between structural or functional deficits and a co-existing speech problem. Nevertheless, this does not preclude the speech-language clinician from making observations of the speech mechanism. In most instances, abnormalities will not be noted, but all variables must be studied in persons who have speech and language disorders.

In general, the examiner should be able to make one of the following three judgments about each structure or function after administering the OSMSE. The first possibility is that the anatomical structure or behavior seems normal and that no further testing is necessary. It must be noted that "normal" here is not intended to preclude any kind of subtle medical or dental problem. Instead, "normal" is intended to denote general intactness in structure and/or function with no obvious conditions or deficits that might adversely affect speech or language. The speech-language pathologist is not trained to make medical/dental diagnosis and is ethically obligated to refrain from doing so.

The second possible interpretation, therefore, for any given object of examination is referral to another professional. Suspected facial, lingual, palatal, or other structural abnormalities should be brought to the attention of the client's physician. Clients with evidence of paralysis, palatal fistulae, velopharyngeal inadequacy, and other less common conditions should be referred to appropriate medical specialists such as neurologists or otolaryngologists. Children or adults with obvious dental health conditions, such as severely decayed teeth, should be referred to a dentist, and persons with suspected occlusal difficulties ought to be referred to orthodontists.

The third possible interpretation from the screening examination is the decision to do further in-depth testing. For example, if screening procedures indicated the possible existence of velopharyngeal inadequacy or oral apraxia, further testing should be done 1) to verify the problem and 2) to describe it fully. After such in-depth testing, referrals to, or consultations with, other professionals may then be warranted.

Lips

Importance in Speech Production The lips are the most visible of the articulators used in the speech production system. Lip articulations are necessary in the formation of certain vowel and consonant speech sounds; they may serve either a primary or secondary role (MacKay, 1978). For example, the lips are the primary point of articulation in the production of bilabial sounds such as the stop plosives /p/ and /b/. In addition, the lower lip and upper teeth constitute the articulatory placement for the fricative pair /f/ and /v/. Other speech sounds have different points of articulation but also exhibit labial movements. Lip rounding is a secondary feature that accompanies the production of sounds like the high back vowel /u/. Conversely, other sounds such as the high front vowel /i/ may show lip spreading. It is important to note that the actual degree of secondary lip involvement with any sound is highly dependent on coarticulatory influences (Daniloff and Moll, 1968).

Appearance and Structure The lips form the orifice or anterior opening of the oral cavity and are composed of muscular and glandular tissue (Zemlin, 1968). The outer labial surface is composed of skin and the inner surface is mucous membrane. Figure 2 is an illustration of the labial structures. The outer skin surface of the lips terminates into an elevated white line, or mucocutaneous ridge. The distinctive curvation of the upper lip is referred to as Cupid's bow (Brescia, 1971). The red zone between the skin and mucous membrane is a transitional area that is also called the vermillion zone. Muscular activity of the lips is primarily a function of the orbicularis oris muscle. It is an unpaired muscle that completely encircles the oral opening.

Typical Deviations In general, lip movements do not require precise adjustments in speech, consequently, there can be a wide range in acceptable muscular function (Spriestersbach, Morris, and Darley, 1978). Asymmetrical appearance, as in the case of scarring from a cleft lip repair, is not direct evidence of a lip mobility problem. Spriestersbach, Moll, and Morris (1961) indicated that observable lip deviations do not play a major role in the speech problems exhibited by cleft palate speakers.

Other problems that may result in lip movement deficiencies are related to impairment of the nervous system. Darley (1978) classified expressive neurological disorders into two distinct types. Speech disorders that occur because of deficits in neural innervation are classified as dysarthrias, and problems resulting from impairment in the organization of phonemes and sequences of phonemes are referred to as apraxia of speech. The dysarthic patient exhibits a motor speech disorder that can manifest itself in muscular weakness, lack of muscle tone, uncoordinated movement, reduced speed of movement, or some combination of the various aberrations (Darley, Aronson, and Brown, 1975). An individual with apraxia of speech does not demonstrate the above characteristics, but instead shows deficits in the organization and execution of articulatory movements. The patient with dysarthria may show deficiencies within the entire biocommunication system or isolated impairment that is attributable to very specific neural lesions. Darley et al. (1975) identified

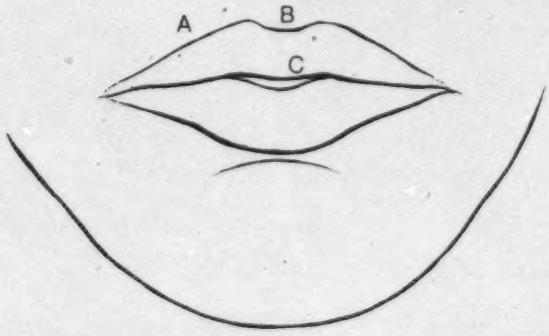


Figure 2. The surface anatomy of the lip. A—mucocutaneous ridge, B—Cupids bow, C—vermillion zone.

specific speech symptomatology that correspond to various types of neural innervation impairment in the central or peripheral nervous system. An individual with bilateral lip involvement of a lower motor neuron origin will often show a characteristic posture at rest, which is depicted in Figure 3. There is a weakness of the facial muscles in general. The labial opening is approximate with the mandibular teeth and there is a downward curving of both the upper and lower lips. The nasolabial fold is accentuated upon inspection (Bosma, 1976). This type of lesion can have a serious consequence for speech because the lips are a major point of articulation for the sounds /p,b,m,w/. They are also important in the production of the /f/ and /v/ sounds and the back vowels /u,ʊ,o,ɔ/; however, the actual extent of the speech disorder is dependent upon the extent of the neurological involvement.

In the case of unilateral lower motor neuron involvement, there is an observable asymmetry at rest. The involved side is lower than the uninvolved side of the labial musculature (Darley et al., 1975). During movement activities, the uninvolved side will move upward and laterally. A unilateral lesion generally has little effect on the labial articulations produced by an individual with such impairments.

It should be noted that the above descriptions are suggestive of dysarthria; however, such limited observation with the OSMSE does not allow for differential diagnosis of the disorder. Differential diagnosis can only be determined through careful study with a battery of evaluative instruments. This caution is also true for those persons whose behavior suggests apraxia of speech. The primary feature of apraxia of speech is articulatory inaccuracy and, to a lesser degree, prosodic alterations (Darley, 1978). In addition, some individuals experience difficulty when required to perform a voluntary nonspeech movement or a sequence of movements (LaPointe and Wertz, 1974). The OSMSE contains items wherein the client must execute certain nonspeech labial movements such as rounding the lips. Consequently, the performance of an individual on the nonspeech lip movements may furnish useful information that can be employed with other pertinent diagnostic data.

Figure 3. An illustration of a person with weakness of the facial muscles. The labial orifice is approximate with the mandibular teeth and there is a downward curving of both the upper and lower lips.

Tongue

Importance in Speech Production The tongue is one of the most important articulators because it plays a major role in the formation of many speech sounds (Daniloff, 1973). Movements of the tongue can change the configuration of the oral cavity, thereby altering the resonating features of the vocal tract. Tongue adjustments can also include complete occlusion of the vocal tract, partial constriction, and various other maneuvers that act to modify the breath stream during speech production.

In vowel production, the configuration of the vocal tract is regulated by muscular activity of the tongue, velum, pharynx, mandible, lips, epiglottis, and larynx (Minifie, 1973). The tract is relatively open and the tongue assumes certain positions that are classified in reference to points within the vocal tract. The laryngeal sound source is then selectively modified through the changes brought about in vocal tract configuration.

If the tip and blade of the tongue are elevated in close approximation with the alveolar ridge, the resultant vowel is a front vowel. When the dorsum of the tongue is near the velum or posterior pharyngeal wall, a back vowel is produced. Central vowels are produced with either no pronounced point of tongue approximation or approximation near the hard palate. Within each of the points of articulation there are also various degrees of vocal tract constriction that include: high, mid, and low tongue positions. For example, the front vowel /i/ is a high vowel because the tip and blade are close to the alveolar ridge; however, the constrictive tongue-alveolar position is not as great with the low, front vowel /æ/. In addition to tongue positioning, other physiologic factors that influence vowel production are the degree of lip rounding and muscular tension (Minifie, 1973).

One of the major differences in production between vowels and consonants is the degree of constriction within the vocal tract (MacKay, 1978). Consonant speech sounds generally exhibit more constriction than vowel sounds, and the tongue plays a major role in the production of a majority of consonants. In the case of lingual stop plosives, there is first a complete occlusion of the vocal tract with either a lingua-alveolar or lingua-velar point of articulation and then release or explosion. The lingual fricative sounds are continuants, made with very narrowed constrictions that are created by the placement of the tongue in close approximation with other articulators. The English affricates combine production features of the above consonant sounds because there is complete occlusion by the tongue and sustained production following occlusion release. The glide and nasal sounds are continuants that do not demonstrate extensive vocal tract constriction. With the exception of the nasal sound /m/, all other glides and nasals are produced with movement of the tongue.

The discussion concerning vowel and consonant production is brief but it does demonstrate the importance of the tongue in speech production. It is a highly mobile articulator that is capable of making very fine adjustments, thus altering the configuration of the vocal tract.

Appearance and Structure For purposes of articulatory description, the tongue is divided into four parts that include the tip, blade, dorsum, and root (Daniloff, 1973). The lateral view perspective presented in Figure 4 illustrates the parts of the tongue.

The tongue is situated in the floor of the mouth and has numerous attachments with other adjacent structures (Kaplin, 1971). The inferior surface is connected to the mandible, and the lingual frenum arises to connect in midline with the underside of the tongue. The upper tongue surface is divided into lateral aspects by the longitudinal median sulcus. The sulcus extends posteriorly to a pit-like structure that is known as the foramen cecum. The sulcus terminalis is a groove-like landmark that runs laterally and forward to the foramen cecum.

Zemlin (1968) listed eight muscles that make up the lingual anatomy. The muscles are classified into intrinsic and extrinsic muscle groups. A listing of the individual muscles according to muscle group is presented in Table 2. All lingual muscles are paired with the exception of the superior longitudinal muscle.

The intrinsic lingual muscles are very important in the movement and shaping of the tongue (Daniloff, 1973). According to Zemlin, contractions of the unpaired superior longitudinal muscle act to shorten the tongue or curl the edges and tip upward. The inferior longitudinal muscle can either

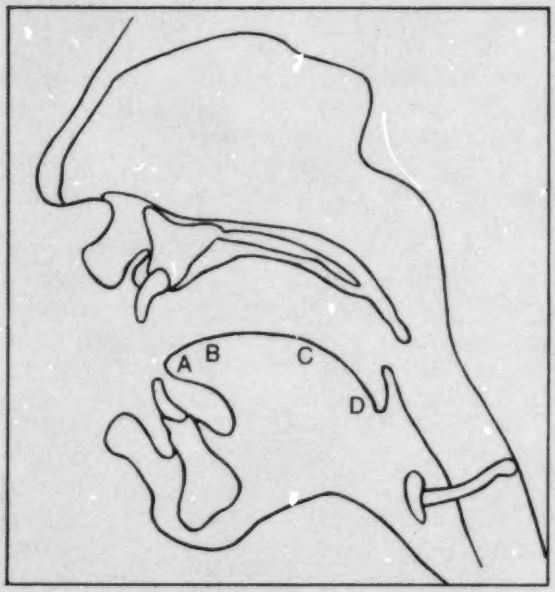


Figure 4. A lateral view perspective of the tongue as situated within the oral cavity. A—tongue tip, B—tongue blade, C—tongue dorsum, D—tongue root.

shorten the tongue or depress the tip downward. Narrowing and elongation of the tongue are brought about through action of the transverse muscle. The final intrinsic muscle, the vertical muscle, flattens the tongue.

The extrinsic muscles have their origin from other structures and insert into the tongue (Zemlin, 1968). The genioglossus is an extremely large muscle that makes up a great portion of the bulk of the tongue. Contractions of the various muscle fibers shape the tongue into a number of different positions. The posterior fibers pull the tongue forward to allow protrusion of the tip from the mouth. Tongue retraction is achieved through action of the anterior fibers, and contraction of the entire muscle pulls the tongue downward. Actions of the styloglossus muscle are responsible for upward and backward movement of the tongue. Contractions of the muscle may also assist in drawing the lateral margins of the tongue upward.

The glossopalatine is listed as an extrinsic tongue muscle; however, it is sometimes classified as a muscle of the palate. In the latter case, it is then classified as the palatoglossus muscle. Action of the glossopalatine muscle is thought to elevate the back of the tongue or lower the velum. Contraction of the hyoglossus muscle results in a backward and downward tongue position. In addition to its lingual influence, the muscle may aid in hyoid bone elevation.

Typical Deviations In discussing the clinical ramifications of certain OSMSE findings, the same caution mentioned in the Lips section should be followed. That is, certain observations of abnormality in structure or function do not in themselves constitute a differential diagnosis. The

Table 2. The intrinsic and extrinsic muscles of the tongue

Intrinsic Lingual Muscles	Extrinsic Lingual Muscles
Superior longitudinal muscle	Genioglossus muscle
Inferior longitudinal muscle	Styloglossus muscle
Transverse muscle	Glossopalatine muscle
Vertical muscle	Hyoglossus muscle

OSMSE results furnish information that is to be used in conjunction with other evaluation methods and procedures.

Inspection of the tongue at rest is carried out with the patient's mouth open and tongue within the oral cavity. Darley et al. (1975) suggested that the tongue should be examined to determine whether it seems normal in shape. Important clinical signs that may be suggestive of neurological involvement include furrowing along the tongue surface or a tongue that seems shrunken. In the case of unilateral involvement, the involved side may seem smaller than the uninvolved side or furrowed.

The speech-language pathologist may evaluate an individual with aglossia, or the absence of a tongue, although this is rare. The disorder can be caused by some congenital or acquired problem (Ewanowski and Saxman, 1980). Treatments for oral cancer sometimes involve the excision of lingual tissue or glossectomy. The extent of the disease process will determine whether a partial or complete glossectomy is necessary. *Microglossia* is a term that refers to an abnormally small tongue; *macroglossia* refers to an unusually enlarged tongue.

The lingual frenum is viewed when the patient has elevated the tongue. There are no specific guidelines in evaluating the adequacy of the lingual frenum in relation to tongue mobility. Moreover, diagnosis of ankylglossia, or tongue-tie, is difficult because there are no actual measurement procedures. This diagnosis would be merely conjecture on the part of the examiner. The patient may have difficulty making tongue tip contact with the alveolar ridge and the tongue surface will assume a heart-shaped appearance upon protrusion between the central incisors (Spriestersbach et al., 1978). Fletcher and Meldrum (1968) developed a measurement technique for studying lingual relationships; however, there are no normative data to permit comparisons among patients. Eisenson and Ogilvie (1963) suggested that ankylglossia occurs very infrequently.

Additional observations of the tongue during movement are noted during the nonspeech function tasks. Unilateral neurological involvement (Figure 5) will result in deviations of the tongue to the involved side (Darley et al., 1975). The effect of unilateral involvement on articulation is generally

Figure 5. A person with unilateral paresis of the tongue. Upon protrusion the tongue deviates toward the affected side.

only minimal. The patient with bilateral impairment will exhibit movement difficulties and articulatory problems. There will be a general imprecision of consonant articulation and a distorted production of vowel sounds. As discussed above, patients with apraxia of speech may also demonstrate oral apraxia and exhibit difficulty when required to execute the nonspeech lingual movements.

During the OSMSE examination, one may observe what seems to be "tongue thrust" or "reverse swallowing." That is, the tongue is thrust forward during the act of swallowing and the behavior is thought to contribute to dental occlusion problems. The behavior can be recorded on the examination sheet; however, Mason and Simon (1977) said that the identification of tongue thrust is not necessarily indicative of a clinical speech abnormality. Little is known about the disorder and its possible influence on speech and occlusion (Joint Committee on Dentistry and Speech Pathology, 1975).

Teeth

Importance in Speech Production The teeth are the most prominent fixed articulators within the oral cavity. They provide the point of primary constriction for several English phonemes, such as the /f/–/v/ and /θ/–/ð/ cognates. In addition, the teeth, particularly the anterior incisors, serve as fixed objects against which air is directed to generate high frequency acoustic energy, as in /s/. There is also little doubt that the molars serve as boundaries and guides for lateral and posterior tongue placement in such sounds as /l/, /ɜ/ and the /k/–/g/ cognate pair. In fact, it is likely that the teeth play a role in the articulation of all English phonemes, including vowels (Zemlin, 1968).

Appearance and Structure The human dental arch is composed of two groups of teeth, the early deciduous teeth and the later permanent teeth. Whereas both deciduous and permanent dentition originate early in embryonic development in the human fetus, the deciduous teeth erupt first, and then are gradually replaced by permanent teeth. Considerable variability is observed in the age of eruption of specific teeth, proceeding generally from the anterior teeth first, which are followed, in turn, by cuspids (canines) and molars. The only major exception to this pattern is that the first permanent molars are often the first permanent teeth to erupt. According to Sicher and DuBrul (1975), the deciduous teeth erupt, on the average, between the ages of 7½ months to 2 years. The permanent teeth erupt between the ages of 6 to 21 years. Excluding the third molars ("wisdom teeth"), the average range for permanent teeth eruption is reduced to the range of 6 to 13 years.

As is the case with all of the anatomy of the speech mechanism, it is important for the speech-language pathologist to become familiar with specific terms that relate to dental anatomy. Figure 6 is a sketch of a dental arch showing the terms typically used by dentists and orthodontists to describe dental locations. Each tooth can be described in relation to its closest soft structure: lips (labial aspect) and cheeks (buccal aspect) on the outside and tongue (lingual aspect) on the inside. Also, taking the anterior center as the median, each tooth can be described with respect to location or movement either toward (mesial) or away from (distal) the median line.

In addition to descriptions of individual teeth within the upper (maxillary) and lower (mandibular) arches, the teeth are described with reference to how they bite together. This is called occlusion.

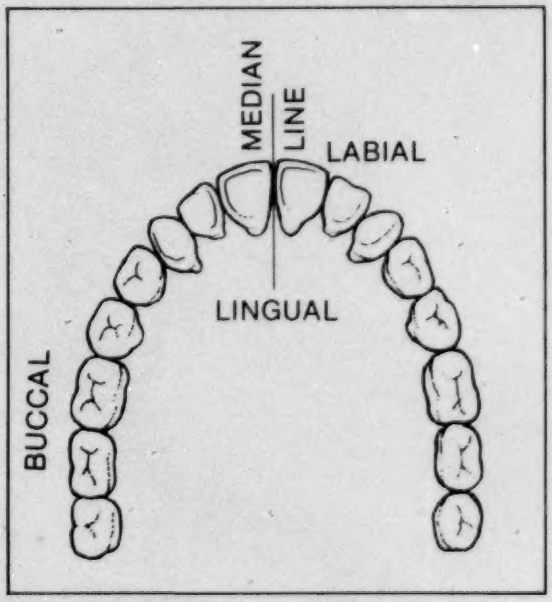


Figure 6. Anatomical frame of reference for the dental arch.

Within each full deciduous dental arch, from medial to lateral, the following teeth are found: central incisors, lateral incisors, cuspids (canines), first molars, and second molars. There are, therefore, 10 maxillary deciduous teeth and 10 mandibular deciduous teeth for a total of 20 teeth. Figures 7 and 8 show lateral and anterior views of normal deciduous dentition. As can be seen, the maxillary arch is larger than the mandibular arch and generally overlaps it on the front and both sides in normal occlusion.

The occlusion of the upper and lower first molars is typically used as an index of posterior occlusion. In Figure 7, the mandibular first molar is slightly anterior to the maxillary first molar. It should be noted, however, that deciduous first molars often come together in an end-to-end relation.

Each permanent dental arch contains 16 teeth, from medial to lateral, as follows: central incisors, lateral incisors, cuspids (canines), first bicuspids (premolars), second bicuspids (premolars), first molars, second molars, and third molars. Figures 9, 10, and 11 show lateral, anterior, and posterior views, respectively, of normal occlusion of the permanent dental arches. Again, it is obvious that the maxillary arch is larger than the mandibular arch. The lateral view shows clearly that each maxillary molar is about one-half its antero-posterior length posterior to the analogous molar in the mandibular arch. The first molar landmark, therefore, is characterized by a one-half tooth disparity in vertical alignment.

Figures 10 and 11 show very clearly the normal anterior occlusal relationships of the incisors. The larger maxillary incisors project anteriorly over the mandibular incisors by about one-third of their length (Sicher and DuBrul, 1975). As can be seen on the anterior occlusion section of the OSMSE score form, the central incisors should come together so that the incisal edge of the mandibular incisors contact the inner surface of the maxillary incisors.

As noted above, children between the ages of 6 to 13 are typically in the mixed dentition stage. Figure 12 illustrates the full dental arches of an 8-year-old child with permanent first molars, maxillary and mandibular central incisors, and mandibular lateral incisors. The remaining incisors, cuspids, and molars are deciduous. Note that the first permanent molars erupt after the deciduous

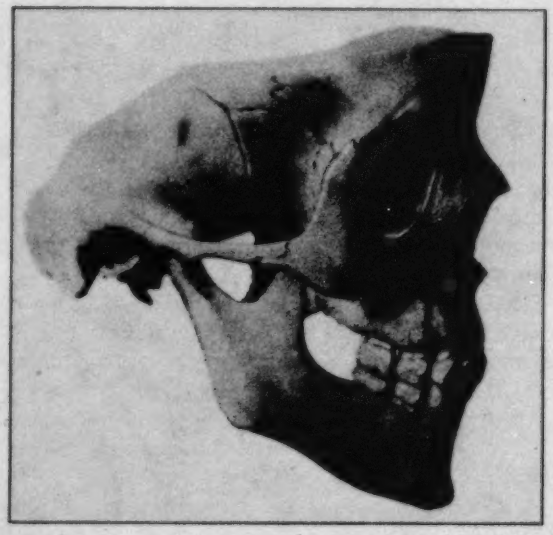


Figure 7. Normal occlusion of deciduous dentition, lateral view. [From Sicher, H., and Tandler, J., *Anatomie fur Zahnartze*. © 1928. (Berlin: J. Springer). Reprinted by permission.]

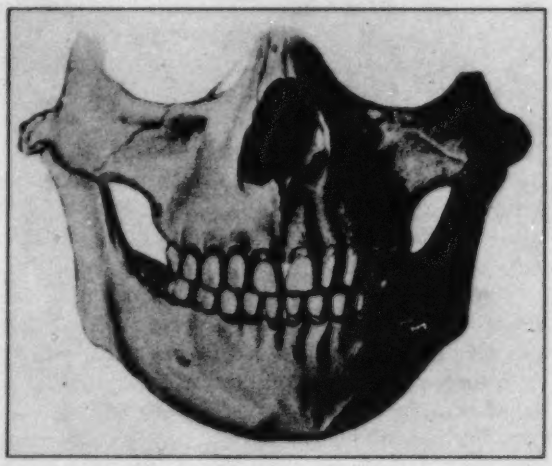


Figure 8. Normal occlusion of deciduous dentition, anterior view. [From Sicher, H., and Tandler, J., *Anatomie fur Zahnartze*. © 1928. (Berlin: J. Springer). Reprinted by permission.]

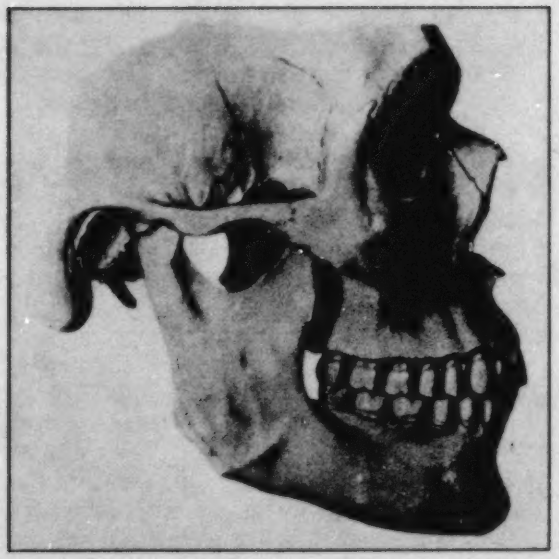


Figure 9. Normal occlusion of permanent dentition, lateral view. [From Sicher, H., and Tandler, J., *Anatomie fur Zahnartze.* © 1928.(Berlin: J. Springer). Reprinted by permission.]

Figure 10. Normal occlusion of permanent dentition, anterior view. [From Sicher, H., and Tandler, J., *Anatomie fur Zahnartze.* © 1928. (Berlin: J. Springer). Reprinted by permission.]

second molars. The figure illustrates that the deciduous molars will eventually be pushed out by the first and second bicuspids (premolars).

Typical Deviations Deviations in the location of teeth can be divided into malocclusions and malalignment of individual teeth.

Malocclusions are characterized by abnormal or unusual bite relationships between the maxillary and mandibular dental arches. Most speech-language pathologists are familiar with Angle's (1907) three classes of malocclusions based on the position of the first molars. Angle's Class I malocclusion (neutrocclusion) is characterized by normal first molar bite but a wide variety of occlusal problems of the anterior teeth. In the Class II malocclusion (distocclusion), the maxilla is protruded anteriorly relative to the mandible. Class II malocclusions are of two types. The first division involves maxillary incisors that protrude outwardly (labioverted), a condition often called "buck teeth." The second division involves retruded (linguoverted), maxillary central incisors with labially and mesially tipped lateral incisors. Figure 13 shows a cast of a typical class II, Division 1 malocclusion. Angle's Class III malocclusion (mesiocclusion) involves a retruded or retracted maxilla relative to the mandible as shown in Figure 14.

The terms distocclusion and mesiocclusion are often a source of confusion to speech-language pathologists who use them infrequently. Therefore, a descriptive statement of the relation of one dental arch to the other should accompany the use of such terms in the oral examination report.

Anterior occlusal problems, that is, malocclusions of the incisors and cuspids, are not uncommon and may occur with or without molar malocclusions. Following are descriptions of some of the most common anterior malocclusions. When the maxillary incisors cover more than one-third of the

Figure 11. Normal occlusion of permanent dentition, posterior view. [From Sicher, H., and Tandler, J., *Anatomie fur Zahnartze.* © 1928. (Berlin: J. Springer). Reprinted by permission.]

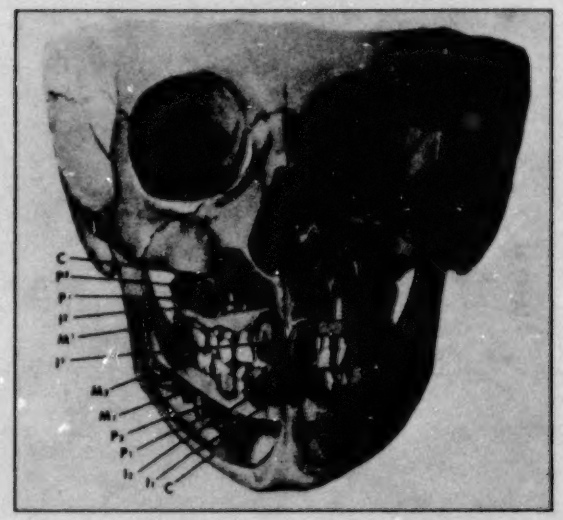


Figure 12. Normal occlusion of "mixed" dentition in an 8-year-old child. [From Sicher, H., and Tandler, J., *Anatomie fur Zahnartze.* © 1928. (Berlin: J. Springer). Reprinted by permission.]

mandibular incisors, the resulting condition is called *close bite.* In extreme cases of close bite, the posterior teeth (molars) do not approximate (Zemlin, 1968). The opposite condition, in which the biting edges of the incisors do not close (as viewed from the front) when the molars are occluded, is called *openbite.* Openbite may occur bilaterally or unilaterally (Zemlin, 1968). If the maxillary incisors extend anteriorly beyond their mandibular counterparts, this occlusal deviation is called *overbite.* It should be noted that many authors and clinicians prefer the term *overjet* for this condition.

The significance of malocclusions in speech production is not entirely clear. In a careful review of the pertinent research, Winitz (1969) concluded that occlusal deviations are not clearly related to articulation errors. Nevertheless, there is some suggestive evidence that neutrocclusion is less likely to be associated with articulatory deviations than either distocclusion or mesiocclusion (Fairbanks and Lintner, 1951). Also, according to Bloomer (1971), the clinical experience of many early speech pathologists indicates that distocclusion is more often associated with articulation errors than mesiocclusion. Regardless of the type of molar malocclusion, however, the sounds most frequently reported to be in error are the sibilants /s/, /z/, /ʃ/, /ʒ/, /tʃ/, and /dʒ/, and occasionally the speech sounds /f/, /v/, /θ/, and /ð/ (Bloomer, 1971; Winitz, 1969; Luchsinger and Arnold, 1965).

The relationship between articulation and malocclusion or malalignment of the anterior teeth is likewise far from clear. Nevertheless, certain tentative findings do emerge from the literature. Reviews by Bloomer (1971), Starr (1971), and Winitz (1969), all suggest that openbite malocclusions are more likely to be associated with /s/ and /z/ misarticulation than chance occurrence of these sound errors.

Moreover, other factors need to be considered before the significance of any occlusal problem is determined. For example, a recent U.S. Public Health Service Survey, cited by Mason and Proffit (1974), discovered that openbite is roughly five times more prevalent among Black than Caucasian school children.

Anterior occlusal problems—incisor protrusion and openbite—are often implicated, particularly by orthodontists, in the condition known as tongue thrusting (Mason and Proffit, 1974). It has been assumed that excessively forward placement of the tongue either against or between the

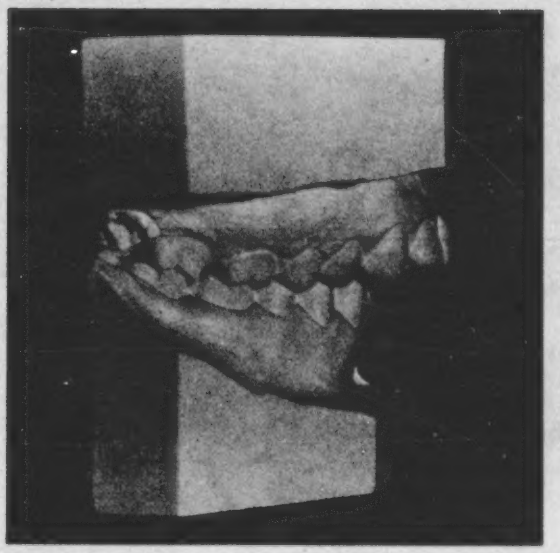


Figure 13. Occlusal relationship showing a Class II malocclusion (distocclusion).

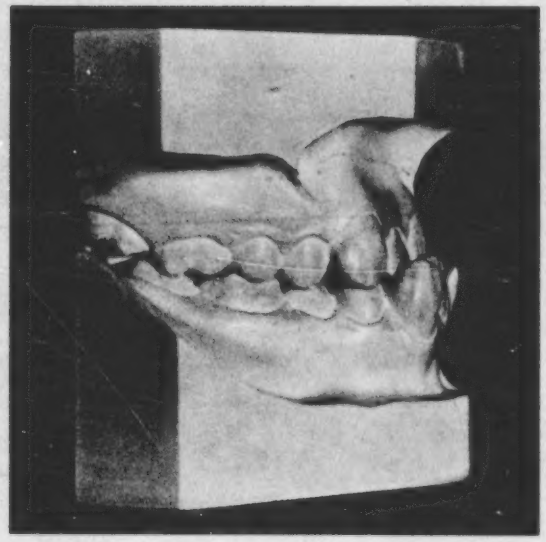


Figure 14. Occlusal relationship showing a Class III malocclusion (mesiocclusion).

anterior teeth, particularly during swallowing, pushes the maxillary incisors anteriorly. Many orthodontists, in the interest of retaining correct incisor location after orthodontia is completed, often enlist the aid of speech-language pathologists to retrain swallowing patterns and prevent unnecessary lingual pressure against the teeth. In many such cases, θ/s (frontal lisp) misarticulations are observed and have been assumed to be part of the problem of tongue thrusting.

After a critical review of the literature pertaining to tongue thrusts, Mason and Proffit (1974) concluded that there is no *predictable* relationship between tongue thrust and either openbite malocclusions or lisping. Dworkin and Culatta (1980) found no differences in anterior openbite malocclusions and tongue thrusts. Also, in the group with malocclusions and tongue thrust, tongue strength was not significantly different between lispers and nonlispers. This study very clearly supports Mason and Proffit's (1974) assertion.

There are a variety of terms used to describe crooked teeth. Such terms are often a source of unnecessary confusion to speech-language pathologists; therefore, they are not included on the OSMSE score form. Nonetheless, the following list of terms, which were suggested by Bloomer (1971) and Zemlin (1968) to describe malaligned teeth, are offered in the unlikely event such descriptions are necessary.

Labioversion—tilted anteriorly (incisors) or antero-laterally (cuspids) toward the lips
Buccoversion—tilted toward the cheeks
Linguoversion—tilted posteriorly (incisors) and or medially (cuspids, bicuspids, and molars) toward the tongue
Mesioversion—tilted medially (incisors and cuspids) or anteriorly (bicuspids and molars)
Distoversion—tilted laterally (incisors and cuspids) or posteriorly (bicuspids and molars)
Torsiversion—correct long axis (not tilted) but rotated on that axis
Axiversion—incorrect long axis inclination
Infraversion—occlusal surface not reaching the occlusal plane of the other teeth ("too short")
Supraversion—occlusal surface extended beyond the occlusal plane of the other teeth ("too long")
Transversion—out of proper sequential order

Other common deviations include: missing teeth, wide spaces between teeth (diastemae), extra (supernumerary) teeth, and various artificial appliances such as dentures, bridges, orthodontic braces, and prostheses.

The effects on speech of malalignment of individual teeth is typically not great. Clinical and research evidence reviewed by Bloomer (1971), Starr (1971), Winitz (1969), and Luchsinger and Arnold (1965) does suggest, however, that there are slightly more misarticulating subjects with dental irregularities than individuals with wholly correct articulation. Again, /s/ and other sibilant distortions are the most commonly reported articulation errors.

The effects of missing teeth on articulation are not altogether clear. Bloomer (1971) reported that loss of all the teeth may result in fricative distortions, particularly the /f/ and /v/ sounds.

A related issue about which considerable confusion exists is the extent to which spaces left by normal shedding of central incisors in young children is a causal factor in articulation errors. Snow (1961) and Davis (1938) found that missing or malaligned central incisors adversely affected fricative sounds, notably /s/ and /z/. Bankson and Byrne (1962) discovered that losing front teeth adversely affected /s/ but not /z/, /f/, and /ʃ/ in kindergarten and first grade children. It seems reasonable to conclude that the normal childhood shedding of the central incisors has no predictable effect on articulation, but that production of the /s/ may be affected. Quite likely, dentition is just one of many determining factors that may result in misarticulation.

Overall, the authors agree with Starr (1971) that without other complicating factors dental deviations rarely impose serious problems in articulation.

Hard Palate

Importance in Speech Production The hard palate forms the roof of the mouth and the structure is very important in the production of many consonant speech sounds (Daniloff, 1973). The tongue can assume contact with the hard palate to occlude the vocal tract completely or tongue-palate approximation may create a narrowing or constrictive point. For example, production of the fricative sound /ʃ/ involves a narrowing of the vocal tract in the palatal area. The tongue tip is elevated toward that portion of the palate that is just posterior to the alveolar ridge. Air is then forced through the small constriction and the resultant fricative sound is produced. In addition to serving as an articulator, the hard palate also partially separates the oral cavity from the nasal cavity.

Appearance and Structure The outer surface of the hard palate consists of mucous membrane (Zemlin, 1968). The membrane is very prominent on the posterior edge of the alveolar ridge appearing in a ridge-like configuration. The ridges or rugae, as they are called, seem to decrease in prominence as a person grows older. A midline raphe or dividing line is generally observable upon inspection of the hard palate. The midline raphe begins just posterior to the rugae and courses the entire length of the hard palate.

The bony framework of the hard palate is composed of the palatine processes of the maxilla and the horizontal plates of the palatine bones. Zemlin (1968) pointed out that the palatine process forms approximately 75% of the bony hard palate and the palatine bone plates make up the posterior 25%. The palatine bone plates join posteriorly in midline and form the posterior nasal spine.

Typical Deviations The configuration of the palate is that of an arched or dome-shaped structure in both transverse and anteroposterior orientations. Of general interest to the speech pathologist is the transverse arch configuration that is presented in Figure 15. The vault height and width are inspected for relative appearance only, because the actual importance for speech of differing palatal configurations has not been established (Zemlin, 1968). Spriestersbach et al. (1978) suggested that the palatal configuration of most persons is generally adequate for communication purposes. Nevertheless, there may be a small number of individuals whose palatal vaults seem very low and narrow, and this vault configuration may impede speech production because many consonant sounds require tongue-palate articulations.

Inspection of the hard palate may reveal such things as scar tissue, clefts, fistulae, or other malformations. Persons who have undergone operations for the repair of a cleft palate may show scarring as the result of corrective surgery. Clinicians may also examine patients who exhibit unrepaired clefts in which the hard palate is affected. Sometimes, portions of a cleft palate are not surgically closed for various reasons, so part of the cleft remains open. When the surgeon chooses

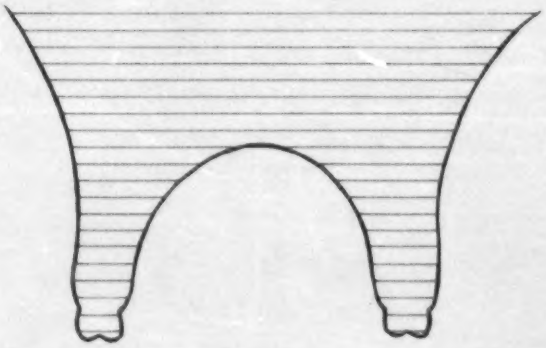


Figure 15. The arch configuration of the hard palate.

to leave a portion of the hard palate cleft open, the defect is generally in the alveolar region (Spriestersbach et al., 1978). Another defect is the presence of a palatal fistula. A fistula is caused by a failure of the healing process following surgery. If a fistula does occur, it will be found along the suture line. Ewanowski and Saxman (1980) suggested that clinicians examine the space between the upper lip and alveolar ridge because a nasolabial fistula might be overlooked. Open defects result in oronasal coupling and may be responsible for hypernasality and nasal air emission.

The final condition discussed here is submucous cleft palate. The submucous cleft can occur in the midline of the hard palate (Grabb, 1971). There is a joining of the oral and nasal mucosa but a failure with bone fusion. Often, the oral mucosa underlying the bony defect will show a bluish tint. Mason and Simon (1977) stated that, in most cases, the posterior nasal spine is absent when a submucous cleft is present. Evaluation of the projection of the posterior nasal spine can be performed by palpation with the finger.

Soft Palate

Importance in Speech Production Movement of the soft palate, or velum, is necessary for the production of all speech sounds. The palate acts to shut off the nasal cavity during the production of oral speech sounds and opens to allow nasal coupling when nasal sounds are formed. This all-or-none description is often used to describe velar activity; however, it is somewhat of an oversimplification for two basic reasons. First, palatal or velopharyngeal closure may vary because of coarticulatory influences in continuous speech (Hixon and Abbs, 1980). The velum may not have sufficient time to achieve complete closure if nasal sounds are adjacent to oral sounds. Second, speakers show differing patterns of velopharyngeal closure during speech (Daniloff, 1973). Some seem to utilize the soft palate almost exclusively, and others utilize a sphincteric action of the palate and pharyngeal musculature.

Appearance and Structure The soft palate is a muscular structure that is attached anteriorly to the palatine bones of the hard palate (Zemlin, 1968). Muscle fibers on the lateral aspects of the soft palate intertwine with fibers of the superior constrictor muscle. The paired muscles of the soft palate are: the palatal levator, palatoglossus, palatopharyngeus, palatal tensor, and the uvular muscle. Zemlin classified the palatal levator and uvular muscles as elevators, the palatoglossus and palatopharyngeus as depressor relaxers, and the palatal tensor as an elevator tensor. (See Figure 16.)

Fritzell (1969) conducted extensive studies of the soft palate musculature through the use of electromyographic and cineradiographic techniques. His data suggests that movement toward velopharyngeal closure resulted in increased activity of the palatal levator and palatal tensor muscles. Conversely, activity of the palatoglossus muscle generally increased when there was movement toward velopharyngeal opening.

Typical Deviations The examination of the soft palate is undertaken both at rest and during speech related activities. The examiner will want to examine the soft palate carefully and note the presence of any scar tissue, fistulae, or other malformations. Much of the discussion in the Hard Palate section can be applied to this section; however, there are some additions that must be mentioned.

A submucous cleft of the soft palate may be identified; the defect sometimes appears with a bluish tint on the oral mucosa. The defect is one of muscular deficiency rather than bone involvement as mentioned in the discussion of the hard palate. Submucous clefts of the soft palate are frequently difficult to identify, but often become unmasked following adenoidectomy (Spriestersbach et al., 1978).

A bifid uvula is another condition that might be discovered during administration of the OSMSE. The normal appearing uvula at midline is instead separated into two uvulae. (Refer to Figure 17 for an illustration.) Statistics presented by Mason and Simon (1977) indicate that a bifid uvula is present in approximately one out of every 75 persons who are examined. Although a bifid uvula may not be significant clinically, it is often a sign of submucous clefting (Ewanoski and Saxman, 1980).

The soft palate may seem asymmetrical at rest if there is unilateral neurological impairment. Aronson (1980) stated that some individuals may demonstrate asymmetries because of former tonsillectomy procedures; however, most do so because of neurological disease. For example, if there is bilateral neurological involvement of the lower motor neuron, the soft palate is depressed, lacks expected arching, and is close to the dorsum of the tongue (Darley, Aronson, and Brown, 1975).

During the speech portion of the soft palate examination, movement is noted and an estimate of velopharyngeal closure is obtained. Asymmetry of movement suggests some type of unilateral neurological involvement; the affected side remains lower than the unaffected side. With bilateral involvement there may be some movement toward closure or a complete lack of movement.

Regardless of the causal agent, velopharyngeal inadequacy may severely affect speech production. Vocal quality may be judged to be hypernasal because there is coupling between the oral and nasal cavities. In addition, the production of oral pressure sounds (plosives, fricatives, and affricates) may be accompanied by audible nasal air escape.

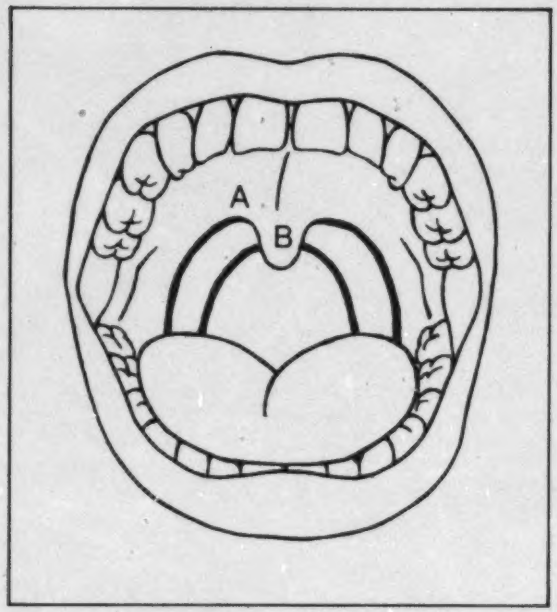


Figure 16. A frontal view of the oral cavity with the soft palate (A) and uvula (B) identified.

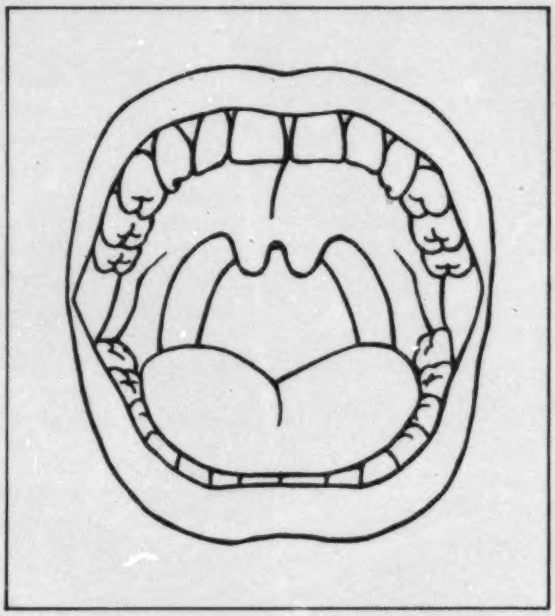


Figure 17. An intraoral view of a person with a bifid uvula.

The nasal flutter test is another informal measure that aids in determining whether further testing is needed. When sustaining production of the vowel /u/ and alternately closing and opening the nostrils, the subject with acceptable closure does not generally show voice quality changes when performing the nasal flutter test. The subject with a suspected closure deficit will usually sound hypernasal with the nostrils open and will show a distinct voice quality change with the nostrils occluded.

The diagnosis of velopharyngeal incompetence from the result of some form of neurological disease or velopharyngeal insufficiency due to some type of structural impairment can only be based on a battery of measures. The authors support the position presented by Shelton and Trier (1976) that velopharyngeal adequacy can only be established in such a manner. Information gathered from the OSMSE will aid in identifying for further testing those individuals with suspected closure deficits.

Pharynx

Importance in Speech Production The pharynx, or pharyngeal cavity, is an integral part of the speech production system. Daniloff (1973) cited a study performed by Kelsey and his associates that shows that alterations in cavity dimension occur during speech production. The pharyngeal cavity is also important as a resonator (Zemlin, 1968). The pharynx is composed of three areas: the nasopharynx, oropharynx, and laryngopharynx; however, here our discussion is limited to the oropharynx. The dimensions of the oropharynx are constantly changing during articulation because of movements of the soft palate and tongue dorsum.

Appearance and Structure The oropharynx is that portion of the pharynx that extends superiorly to the level of the soft palate and inferiorly to the level of the hyoid bone (Zemlin, 1968). Its anterior communication with the oral cavity is through the fauces. The anatomical boundaries of the fauces include: the palatine arches or faucial pillars laterally, the soft palate superiorly, and the dorsum of the tongue, inferiorly. Figure 18 is an illustration of the structures. The anterior faucial pillars are formed by the glossopalatine muscles, which were discussed on page 11. Contractions of this paired muscle act to narrow the anterior faucial arch. The pharyngopalatine muscle makes up the posterior faucial pillar or pharyngopalatine arch. Movements of this paired muscle are important in deglutition.

The palatine tonsils are situated in the tonsillar fossa. The fossa is a triangular space that is present between the anterior and posterior faucial pillars.

Typical Deviations The palatine tonsils are typically quite easy to observe in young individuals. In certain instances, the tonsils may be so large that they contact in midline, and the enlargement adversely affects speech (Spriestersbach et al., 1978). The incidence of such disorders, however, is thought to be quite limited in the general population. The tonsils generally atrophy during puberty.

When observing the oropharyngeal area during phonation of the vowel /a/, many speakers show lateral movement during velopharyngeal closure. That is, movement toward the center of the lateral and posterior pharyngeal walls helps in a person's achievement of velopharyngeal closure. This should be noted because different speakers show different patterns of velopharyngeal closure. (Differential closure patterns are discussed in the Soft Palate section.)

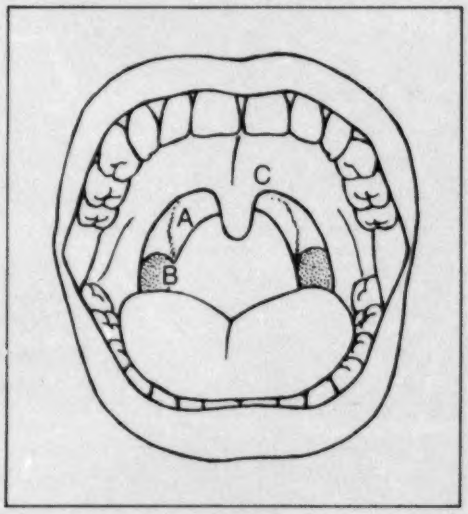


Figure 18. A frontal view of the oral cavity. The faucial pillars (A), palatine tonsils (B), and soft palate (C) are marked.

Breathing

Importance in Speech Production The importance of breathing in speech production is unquestioned. Without adequate breath support and controlled exhalation, vocal speech would be impossible. The complex but important functions of the role of breathing in speech are clearly summarized in the following description by Hixon (1973):

> The ease with which breathing occurs in speech gives little hint as to the important role the respiratory pump plays in man's ability to communicate orally. Viewed broadly, that role is to provide the driving forces necessary for the generation of sounds, those forces being supplied in the form of pressures and flows which act upon and interact with various structures within the head and neck. To be more specific, the respiratory pump participates in speech by displacing structures, creating pressures behind valves, and generating flows through constrictions within the larynx and upper airways. These activities, in association with intricate and rapid maneuvers of other parts of the speech apparatus, create the disturbances of air that constitute speech at the acoustical level. Since respiratory forces provide the basic energy source for all speech and voice production in the English language, the events of speech respiration are of fundamental importance in any account of oral communication. Within the broad spectrum of physiological function in speech, the respiratory pump is involved in the regulation of such important parameters as speech and voice intensity (loudness), vocal fundamental frequency (pitch), linguistic stress (emphasis), and the division of speech into various units (syllables, words, phrases, etc.) (pp. 98-99).

In spite of the undisputed importance of breathing in speech, many recent authorities do not include a specific assessment of breathing as part of an oral examination (Emerick and Hatten, 1979; Dworkin, 1978a; Spriestersbach et al., 1978; and Mason and Simon, 1977). Other sources (Hutchinson, Hanson, and Mecham, 1979; Nation and Aram, 1977) do include a cursory evaluation of breathing patterns. Several reasons may account for the lack of inclusion of breathing patterns in many oral examinations. For example, the reliability—and even the accuracy—of making such judgments as "abdominal," "thoracic," and "clavicular" breathing patterns is questionable. Recent research in respiratory function (e.g., Hixon, 1973) has shown that the process of breathing is extremely complex and requires highly sophisticated instrumentation to make accurate and reliable measures. Another possible reason for not assessing breathing is that respiration is rarely affected in clinical patients enough that speech or voice is adversely affected. The major exceptions to this involve neurologically impaired populations, such as those with cerebral palsy or acquired dysarthria.

Appearance and Structure A great many muscles are involved with respiration. In general, muscles that increase the volume of the lungs are considered to be muscles of inhalation; those that have the effect of decreasing lung volume are muscles of exhalation. Both inhalation and exhalation phases of respiration utilize different muscle groups that further depend on whether the individual is engaged in quiet or forced breathing (as in physical exertion or shouting) (Hixon, 1973; Zemlin, 1968).

The major muscle of inhalation is the diaphragm, which is an upwardly dome-shaped layer of muscle tissue that essentially separates the heart and lungs inside the rib cage from the abdomen. Upon contraction the diaphragm flattens out and enlarges the volume of the thorax. In order to do so, the abdominal muscles must be sufficiently relaxed to allow the force of the descending diaphragm to push the viscera downward and anteriorly.

The external intercostal muscles are also involved in quiet inspiration (Hixon, 1973). These muscles, which course from the bottom of each rib obliquely in an anterior direction to the top of the next lower rib, have the net effect of elevating the rib cage. This, by virtue of the structure of each rib, increases the anteroposterior and lateral dimensions of the rib cage.[3]

Other muscles which may elevate the rib cage or extend the chest anteriorly come into use in vigorous inhalation. These include elevators from the neck, elevators and tensors from the thorax and shoulder girdle, and extensors from the back (Zemlin, 1968).

During very quiet exhalation, it is doubtful whether any muscle contractions occur. The tendency of the stretched abdominal muscles and intercostals to return to their relaxed state, in con-

[3]The anterior (intercartilaginous) portion of the internal intercostals also participate in inhalation. Nevertheless, the bulk of the internal intercostals are arranged so that they participate primarily in exhalation.

junction with gravity pulling down on the rib cage, is sufficient to reduce the volume of the thorax. During speech, there are small contractions of the internal intercostals and abdominal muscles which depress the rib cage and force the diaphragm upward, respectively. Vigorous exhalation often brings into play other thoracic muscles which flex the spine forward, lower the shoulders, and further depress the rib cage (Hixon, 1973; Zemlin, 1968).

In speech, the typical inhalation/exhalation patterns necessary for life support are modified compared to silent breathing. The inhalation cycle is shortened and the exhalation cycle is extended to provide the necessary air pressure and flow characteristics for voice, articulation, and resonance. Not surprisingly, involvement of specific muscles, pressures, and airflow rates in breathing vary dramatically as the individual proceeds along the continuum from quiet breathing to isolated vowel production, to normal conversational speech, and to shouting. Furthermore, other important influences on muscle movements and aerodynamic movements include the moment-to-moment breathing rate as it is influenced by physical exertion or psychological stress and bodily posture. For these reasons, it is not possible to identify specific breathing patterns, such as "abdominal" or "thoracic," which do—or should—predominate for speech.

Typical Deviations As noted above, breathing is rarely affected in most speech- or language-disordered clients to the extent that speech or voice is adversely affected. The primary exception to this involves individuals with neuromotor involvement of the respiratory musculature. This is not to say, however, that breathing patterns may not be unusual or inefficient. In individuals with a history of vocal abuse, for example, normal respiratory patterns may become disrupted. The speaker may habitually do such things as inhale more deeply—and exhale air more forcefully—than necessary, resulting eventually in physical abuse to the vibrating vocal folds (Boone, 1977). Many stutterers adopt irregular and inefficient ways of using the breathing mechanism during stuttering. Some typical abnormalities include: short inspiratory gasps prior to attempting a word upon which stuttering is anticipated, speaking on expiratory reserve air volume instead of inhaling and speaking on tidal air volume, pauses with long audible inhalations, and antagonistic thoracic and abdominal pumping movements (St. Louis, 1979).

Another inefficient breathing pattern, one about which there is considerable controversy, is so-called clavicular breathing. Clavicular breathing is actually a misnomer; in fact, it refers to raising of the shoulders during inhalation. This is normal in strenuous inhalation when the body requires more than the usual amount of oxygen. As the shoulders are elevated, the volume inside the thorax, and hence lung volume, is increased. If quiet breathing or speech breathing is associated with shoulder elevation, it may indicate that the individual is not allowing the diaphragm to descend sufficiently. Instead, the person contracts the abdominal muscles and prevents the normal anterior extension of the abdomen (Boone, 1977). Some speakers of both sexes adopt a pattern of clavicular breathing in order to maintain the constant appearance of a trim waist and large chest (Hixon, 1975). Obviously, if the diaphragm cannot increase the thoracic volume sufficiently for normal inhalation, the shoulders must be elevated to compensate.

Clavicular breathing is not included on the OSMSE because it may not be abnormal (Johnson, Darley, and Spriestersbach, 1963). Nevertheless, the examiner should make note of shoulder elevation during breathing and determine, in further testing, whether a potential breathing problem exists.

The presence or absence of mouth breathing during silence is included in nearly all current examination protocols. Habitual mouth breathing often provides an important clue to some sort of nasal or nasopharyngeal obstruction, such as hypertrophied tonsils or adenoids, deviated nasal septum, or chronic upper respiratory infection (Dworkin, 1978a).

Diadochokinesis

Choosing and Recording Units Rapid alternating movements have long been used as tests of motor skill, coordination, and neuromotor integration. Such tasks, termed diadochokinesia, have been applied to speech-language pathology using a variety of nonspeech and speech movements. Most recent diagnostic sources recommend investigating the maximum diadochokinetic rates for nonsense syllables such as /pʌ/, /tʌ/, /kʌ/, and multisyllable sequences such as /pʌtə/, or /pʌtəkə/ as part of the oral examination (Emerick and Hatten, 1979; Hutchinson et al., 1979; Spriestersbach et al., 1978; Mason and Simon, 1977; Nation and Aram, 1977).

There are basically two ways in which the clinician can count diadochokinetic rates. Both procedures require the client to produce repetitions of the desired unit at maximum rate but either for a specified number of seconds or for a specified number of repetitions. The first variation involves starting a timer, counting repetitions while carefully watching the timer until the specified period of time has elapsed, and then recording the number of repetitions. The second variation involves starting the timer, counting a predetermined number of repetitions produced at maximum rate, and stopping the timer at that point. With this latter procedure, the examiner records the time elapsed. This procedure has been recommended because it simplifies the examiner's task by not requiring careful monitoring of a timer while counting repetitions (Hutchinson et al., 1979; Fletcher, 1972). For this reason, the second method is used in the OSMSE.

As might be expected, data establishing expected diadochokinetic rates for normal and disordered populations have utilized variations of both counting procedures. This being the case, the best way to compare results utilizing either method is to convert them to repetitions per second as was done in the Darley and Spriestersbach (1978) diagnostic text and its earlier edition (Johnson et al., 1963). Therefore, the OSMSE score form provides for recording both the number of seconds immediately after the client's repetitions are counted and repetitions per second after using Table 1 to convert the scores.

Table 1 can be used to convert times between 1 and 10 seconds to repetitions per second. Times are given to the closest one-half second for two reasons. First, most timers could not be used with precision greater than half-seconds, and second, our reliability data suggest that trained examiners vary an average of 0.25–0.35 repetitions per second in a test/retest situation with the same subjects. Times beyond the 10 second limit of Table 1 can be converted to repetitions per second by dividing the number of repetitions counted (16, 12, or 8) by the number of seconds timed.

Significance in Diagnosis Spriestersbach et al. (1978) reviewed a number of studies that indicated that slower than expected diadochokinetic rates may have diagnostic significance for the speech-language pathologist. They provided the following guidelines for determining whether children were in the average category, or were above or below average. For /pʌ/, average children produced between 3 and 6 repetitions per second; for /tʌ/, average rates were between 3 and 5½ repetitions per second; and for /kʌ/, average rates were from 3 to 5 per second. The normative data from Fletcher's (1972) elementary age children (6 to 10 years) correspond with these guidelines for repetitions of /pʌ/, /tʌ/, and /kʌ/. For /pʌtə/, Fletcher's children produced between 2 and 3 repetitions per second.

The guidelines for /pʌtəkə/ are not so clear. Yoss and Darley (1974) and Leshkin (1948) found average rates for children between 3 and 4 repetitions per second. On the other hand, Robinson (1973) and Fletcher (1972) reported rates between approximately 1 and 1½ repetitions per second for the task. It is likely that the examiner's decision of what to do about sequencing errors and other errors influences the rate for multisyllable repetition tasks. For example, Yoss and Darley (1974) reported that only one-third of their 5- to 9-year-old subjects with defective articulation could repeat /pʌtəkə/ accurately enough to be scored. Robinson (1973) found that about 20% of normal 5-year-olds could not produce "puh-tuh-kuh" repetitively. Failure rates dropped to about 10% for 6-year-olds and 3% for 7-year-olds.

Slower than average diadochokinetic rates have been reported for a variety of speech/language disorders, but, for the same disorders, other studies frequently have not found delays to be signifi-

cant. After a careful review of studies comparing diadochokinetic rates for articulatory defective and control groups, Winitz (1969) concluded that studies that showed significant delays involved speech movements. Because other studies using nonspeech movements revealed no significant differences, Winitz suggested that a history of articulation errors could account for the differences. He concluded that there was no convincing evidence that articulatory defectives were slower than average diadochokinetic tasks. On the contrary, Dworkin (1978a) and Yoss and Darley (1974) reported substantial delays in diadochokinetic rates in children with moderate to severe articulatory defects and frontal lisps, respectively.

The data for stutterers and other disorders such as Parkinsonism are also equivocal (Kreul, 1972; Rickenberg, 1956; Strother and Kriegman, 1943). Nevertheless, Darley et al. (1975) reported that delays in diadochokinesis can be symptomatic of neuromotor dysfunction.

As in most of the variables tested in the OSMSE, diadochokinetic rates cannot *predict* speech disorders. The oral examination, however, is rarely administered with this purpose in mind; the examiner typically knows—or strongly suspects—that a particular speech or language disorder exists. The examiner's task is to discover as much as possible about the nature of that known or suspected disorder. The findings regarding diadochokinetic rates can be best used in this way. For example, if an articulatory defective client has slow and irregular repetitions of single syllables and has difficulty articulating bisyllables and trisyllables in sequence, the neuromotor integrity of this client may be involved etiologically in his or her disorder (Yoss and Darley, 1974). On the other hand, if the client has normal diadochokinetic rates and rhythms, the examiner would be unlikely to seriously consider neuromotor dysfunction as a causative factor.

RELIABILITY

The establishment of examiner reliability was determined by administering the OSMSE to 60 subjects. The experimental subjects were equally divided into groups of second graders, fifth graders, eighth graders, and college students. The mean age for each of the groups was 7.5, 10.3, 13.1, and 19.9 years, respectively. Prior to administration of the OSMSE, each subject was given the Templin-Darley Screening Test of Articulation (1960) to ensure that all persons were free from any articulatory defects. The OSMSE was given to the subjects by either of two graduate students in speech pathology (Examiners A and B); both students were trained in administering the screening examination before evaluating the test group.

Following the initial OSMSE examination, four subjects from each age group were randomly selected and retested approximately 1 week later. Both examiners evaluated two subjects who they had previously tested and two who had formerly been tested by the other examiner. Reliability indices were determined from an item by item count on all judgments except diadochokinetic rates. The mean agreement figures for the examiners are reported in Table 3. The mean intra-judge agreement for Examiner A was 95.5% and the range was 93.5% to 100%. Examiner B had a mean intra-judge score of 98.4% with the range between 90.6% and 100%. Mean inter-judge agreement was 95.1%; the range of scores was from 83.8% to 100%.

Accuracy data for diadochokinetic rates was established in a different manner because the task involved both counting and timing speech repetitions. "Standard" counts and times were found by two additional speech pathology students who independently retimed and recounted all subjects' diadochokinetic rates from audio tape recordings. After the "standard" counts and times were determined, the repetition rate per second was computed by dividing the number of seconds into the number of repetitions. The "standard" repetition rates per second were then compared with the original data and difference scores computed. The mean difference score for Examiner A was 0.25 repetitions per second and for Examiner B, 0.35 repetitions per second.

Table 3. Mean agreement figures for intra- and inter-judge reliability

	Mean intra-judge agreement	Mean inter-judge agreement
Examiner A	95.5%	95.1%
Examiner B	98.4%	

In a further extension of above investigation, the OSMSE was given to a group of 16 4- and 5-year-olds who were attending a local nursery school. The mean age of the children was 5.6 years. The results of the articulation screening before administration of the OSMSE showed that 12 subjects exhibited articulation errors, however, their overall scores were at the mean score value or above for their chronological age group. Each subject underwent an OSMSE examination by a single examiner and then four children were randomly selected for retest purposes. Mean intra-judge agreement was 93.2% and the range was between 90.9% and 96.7%. The mean difference score on the diadochokinetic tasks was 0.28 repetitions per second. The determination of the mean difference score was carried out in the same manner as described in the previous section.

The results of the studies indicate that the OSMSE demonstrates satisfactory intra- and inter-examiner reliability and is suitable for use with both children and adults. The time required to administer the screening examination ranged from 5 to 10 minutes in most cases. In our opinion, the preliminary data support the rationale underlying development of the OSMSE. That is, the OSMSE is a screening examination that allows systematic observation of the oral speech structures in a relatively brief period of time.

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ORAL SPEECH MECHANISM SCREENING EXAMINATION

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Name _____ Type of Client _____

Examiner _____ Date _____ Date of Birth _____

SCORING KEY
+ No Deviation Noted
– Deviation Noted
NT Not Tested
NR No Response
X Wrong Response
→ Asymmetry on Right Side
← Asymmetry on Left Side

STRUCTURE	APPEARANCE	NONSPEECH FUNCTION Task	Response
Lips	Symmetry at Rest [ ]: Other Deviations Noted:	Instructions: "Watch me and do what I do." Round Lips Draw Corners Back Close Lips; Puff Cheeks Bite Lower Lip	[ ] [ ] [ ] [ ]
Tongue	Surface [ ]: Frenum [ ]: Other Deviations Noted:	Tip Up Tip Down Tip Right Tip Left Tip Drawn Back Along Hard Palate	[ ] [ ] [ ] [ ] [ ]
Jaw	Occlusion: Lateral View of First Molars Normal Relationship Posterior ← → Anterior ( ) Yes ( ) No; (1) *Sketch* Lower First Molar (2) Check (√) ( ) Maxilla Protruded Anteriorly (Mandible Retruded Posteriorly) (Distocclusion) ( ) Maxilla Retruded Posteriorly (Mandible Protruded Anteriorly) (Mesiocclusion)		
	Lateral View of Central Incisors Normal Relationship Posterior → Anterior ( ) Yes ( ) No; (1) *Sketch* Lower Central Incisor (2) Check (√) ( ) Upper Incisors Cover More Than 1/3 of Lower Incisors ("Closebite") ( ) Upper Incisors Do Not Cover Lower Incisors ("Openbite") ( ) Upper Incisors too Far Anterior Relative to Lower Incisors ("Overbite") ( ) Upper Incisors Posterior to Lower Incisors ("Underbite") ( ) Other Deviations Noted:		

Teeth

Condition:

( ) Obvious presence of caries or decayed teeth:

( ) Gap(s) created by missing teeth (Circle teeth representing gaps):

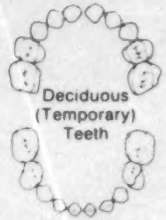
Alignment:

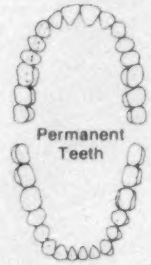
( ) Excessively wide spaces between teeth noted (Draw arrow(s) between teeth):

( ) Excessively crooked teeth noted Describe:

Bridges; Appliances; Prostheses:

Other Deviations Noted:





Hard Palate

Vault Height [ ]:

Vault Width [ ]:

Other Deviations Noted:

Soft Palate

Symmetry at Rest [ ]:

Uvula [ ]:

Other Deviations Noted:

Pharynx

Anterior Faucial Pillars [ ]:

Posterior Faucial Pillars [ ]:

Palatine Tonsils [ ]:

Other Deviations Noted:

Say "ah" (3 trials)

	MOVEMENT OBSERVED		SYMMETRY OF MOVEMENT
	None	Some	
Vertical Movement	( )	( )	( )
Lateral Movement	( )	( )	( )

VELOPHARYNGEAL MECHANISM

	Yes	No
Sustain /u/: voice quality change perceived with nostrils occluded and open	( )	( )
Hypernasality perceived	( )	( )

Breathing

Mouth Breather ( ) Yes ( ) No

Other Deviations Noted:

Diadochokinesis

Task	Number	Time (Seconds)	Repetitions Per Second	Rhythmic Yes	Rhythmic No	Articulation Accurate Yes	Articulation Accurate No
pʌ. pʌ. pʌ	16	_____	_____	( )	( )	( )	( )
tʌ. tʌ. tʌ	16	_____	_____	( )	( )	( )	( )
kʌ. kʌ. kʌ	16	_____	_____	( )	( )	( )	( )
pətə. pətə. pətə	12	_____	_____	( )	( )	( )	( )
pətəkə. pətəkə. pətəkə	8	_____	_____	( )	( )	( )	( )

SUMMARY AND RECOMMENDATIONS: